

## **Governance for Industrial Transformation – The Scope of the Challenge**

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### **Needs and Outline of an Industrial Transformation Research<sup>1</sup>**

Despite considerable efforts in cleaning up industrial production since the emergence of modern environmental policy about 30 years ago, the patterns of economic activities are far from environmental sustainability, especially in the industrialised countries. Many problems remain unsolved, many new problems emerge at the horizon. Climate change, the loss of biodiversity, water stress, soil degradation or the exposition to dangerous chemicals are examples for that. Although some indicators point to a decoupling of economic growth from environmental degeneration, the overall consumption of natural resources and the utilisation of the environment as a sink for emissions exceeds tolerable rates. This calls for an encompassing industrial transformation towards sustainability, in particular in the richer countries of the North.

This is not a new diagnosis. The need of fundamental changes in the patterns of production and consumption has been discussed already since the 1970s. That little progress has been made so far, is not a great surprise, given the scope of the challenges of such an undertaking as the industrial transformation of both rich, industrialised countries and to direct the process of development in the industrialising countries.

Lots of academic work has been conducted to analyse the determinants of unsustainable economies, such as external effects of production processes, problems of internalisation, consumer preferences that are not sufficiently considering the environmental burden of consumption and hence the lacking market signals for a more sustainable production. Many scholars with different scientific backgrounds have undertaken research concerning the questions, which policies and regulations are likely to bring forward the necessary change, which actors are able to enforce these policies and which overall necessities, opportunities, and impediments exist for such policies.

Given the rather dispersed fields of research, there is a need for an overarching framework as it is offered in the Science Plan of the IHDP-IT. There are several characteristics mentioned of what could qualify for Industrial Transformation research:

- Industrial Transformation research deals with the relationship between societal, technological, and environmental change;
- Industrial Transformation focuses on systems and system changes that are relevant in view of the global environment (such as the energy system, the food system, and the urban system); systems are defined as chains of related economic activities

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that provide a specific need for society. Thereby it goes beyond single enterprises, sectors and countries.

- Industrial Transformation research relates producer and consumer perspectives, including the incentives and institutions that help in shaping these perspectives;
  - Industrial Transformation research is international in scope; and
  - The research is necessarily multi-disciplinary, it encompasses economics, political sciences, psychology, sociology and history.
- (Vellinga and Herb 1999).

The overall rationale of IT research is to understand the conditions for changes in the relation of society and the environment that lead to a de-linking of economic activities and environmental burden. How can the desired changes in economy-environment relations effectively promoted? Until now it was mainly the state that has been the most important actor to promote improvements in environmental performance. However, because of the dynamic development of the socio-economic and the political systems it is questionable if past patterns of industrial change are likely to occur also in the future. It is called for new forms of governance in particular to cope with the challenges of economic globalisation.

The modes of governance are changing as well. The transformation in governance is usually described by three trends (s.a. Heritier 2002; Hey, Jänicke et al. 2003):

- the broadening of the spectrum of actors involved in the policy making process, and by this the decline of authority of the central government towards non-state actors. To safeguard the participation of the affected stakeholders it is often called for more democracy and new forms of participation;
- the broadening of the instruments applied, away from command and control towards economic instruments and new flexible, co-operative measures with shared responsibilities of government and target groups; and
- the declining importance of the level of national policy making, while other levels both internationally and subnationally gain additional importance.

What does this mean for policies that aim to contribute to an encompassing Industrial Transformation? Many scholars subsume implicitly all political strategies under the heading of industrial transformation that are able (or aim) to influence the choice of technologies and hence the environmental performance of enterprises, branches or consumers. These approaches can be analysed as end-of-pipe strategies, ecological modernisation or green industrial policies.

However, the above cited IHDP-IT Science Plan takes a different direction: It focuses on systems and system changes that are relevant to the global environment. Thereby, the perspective is broadened to the actors that are involved in the production and consumption, the flow of goods and services, and the institutional setting that frames these activities (Vellinga and Herb 1999). It is open to investigation if this opens up some room for manoeuvre within the above depicted new modes of governance.

In the following, recent contributions of political science on strategies that aim at a greening of industries are analysed regarding their possible contribution to an Industrial Transformation, their degree of difficultness and in how far they are affected by the depicted trends of governance.

### **An analytical framework**

Political strategies can be distinguished regarding the actors and their configuration, the policy style, and the instruments that are applied (s.a. Jänicke, Blazejczak et al.

2000). By this criteria it is possible to describe and to distinguish political strategies, and to assess their likely effects.

- **Actors and their configuration:** Policymakers aim at restricting, determining or broaden the set of feasible alternatives for (groups of) actors or to influence the consequences or the evaluation of their action. Target groups can be firms (both polluting sectors as well as ‘helping’ industries, i.e. producers of environmental technologies, insurance companies, environmental consultants, etc.), private households, but also NGOs, governmental departments or other governments. The selection of a policy measures and their specific design is a complex process. A simple two actors model with the policy maker on the one side and the target group on the other side could not explain the policy output. The internal conditions of the policy making process have to be taken into account as well: The relative strengths of environmental authorities in the government is of importance, their abilities to implement policies, the degree of horizontal (among other departments) and vertical (among other levels of government) integration and fragmentation determines the effectiveness of regulations. Frequently, the target groups of environmental policy do have trustees in ‘their’ governmental departments and by them their interests are well represented in government, objectives of environmental policies are questioned, instruments are applied less strictly. But also the target groups are often not homogenous, in particular if there are innovators that expect to protect their markets by environmental policy measures, the interests of the target group may be fragmented. Policy programmes are developed and implemented in a specific actors’ configuration. Whether a policy is adopted, implemented and turns out to be effective, depends on a large degree on the participation (and the mutual recognition of legitimacy) of the relevant actors. E.g. the chemical policy changed fundamentally after the environmentalists groups became an accepted participant in the policy networks during the 1980s in many western industrialised countries while e.g. in the steel industry environmentalists hardly have an important role and environmental demands are mainly imposed by the public authorities. It is not only governmental actors that issue policies, but also NGOs that may take an equivalent role. Many policy instruments, in particular persuasive instruments are available to private actors as well. Furthermore, NGOs play a vital role in the development of objectives, communicating problems, monitoring the achievement of targets, all of them are important parts of the policy making process.
- **Policy Style:** The effects of policies, in particular those policies that don’t imply a complete determination for the target group, largely depend on the policy style. Policy style describes the manner how a policy is formulated and implemented. Policy maker may seek a consensus with the target group or prefer a strategy of conflict. Their behaviour may be calculable or erratic. In particular the effectiveness and the scope of voluntary approaches depends on the (perceived) readiness to implement regulatory measures in case of failure. Innovation effects of policy instruments rely on credible long-term commitments: E.g. the innovation effects of an eco tax will be higher, if a rise in rates is announced for several years in advance, compared to the same tax that is risen on an ad hoc basis. Policy analysts as well as policy makers have stressed the importance of long-term objectives in particular to stimulate innovations. However, objectives are cannot chosen freely, they are subject of dispute and change in a bargaining process inside government and with the target group. Therefore, policy objectives are frequently based on a minimal consensus between departments, hence unclear, short termed and not operationalised for target groups.
- **Instruments:** The number of possible instruments is limited only by the creativeness of policy actors. There are many typologies in the literature, mostly based on the degree of determination for the target group. It ranges from

voluntary/persuasive instruments over economic instruments (subsidies, taxes, certificates, etc.), to so called “command and control” measures. Furthermore, instruments can be distinguished regarding direct or indirect effects: direct instruments aim at influencing the behaviour of the target group, while indirect instruments stimulate other actors to enforce environmental friendly behaviour. E.g. liability rules creating insurance companies as actors that influence the environmental performance of a firm. More generally, indirect instruments generate helping interests to solve environmental problems. Policy instruments may be demanding - ranging from technology forcing, support for diffusion of improved technologies, to fixing the current technological standards only.

Policies occasionally aim at stimulating competition, and search processes inside the target group. In order to be successful in this direction it is necessary, that regulation does not determine the target groups behaviour completely (in this case, innovation is not necessary), but to remain flexible. That is in particular a goal of the so called 2<sup>nd</sup> and 3<sup>rd</sup> generation of environmental policies.

Different policy instruments are needed for each stage of the development of innovations (Jacob and Jänicke 1998). In early stages, supportive measures are required, and it is necessary to protect innovations from sometimes overwhelming market forces, until learning costs have been refinanced and production is scaled up. In later stages of development, it is more important to support the diffusion of environmental technologies by discriminating the competing old technology, by giving recommendation to adopt to the new technology or by making the new technology even obligatory.

Firms or other target groups are rarely influenced by a single policy measure only, but they are in a most often subject of a complex and hybrid regulatory framework. Thereby, the effectiveness of policy measures depends to a large degree on the institutional, societal and economic context. E.g. a label is effective only if the environmental awareness is high, regulation depend on the capacity for monitoring and enforcement, etc. This may limit also the transfer of policy instruments from one country to another.

The aspect of institutional fit is in particular crucial regarding the adoption of European policies in the Member States. When European policy innovations are implemented by the Member States, the wide range of different regulatory traditions affects the effects of a policy. E.g. the effects of Right to Know acts vary considerable among the Member States. Comparable mechanisms can be expected when it comes to the implementation of multilateral environmental agreements.

There are many different typologies that classify the different approaches of environmental policies, e.g. the distinction of reactive, receptive, constructive and pro-active approaches by Vellinga and Herb (1999) or a comparable typology of Jänicke (1984) who distinguishes measures aiming at repair, end of pipe, ecological modernisation or structural change. Binder (1999) adds to this list the possibility of abandoning economic growth at least as a theoretical possibility to reduce the environmental burden. In the following the strategies for end-of-pipe technologies, for environmental innovations as well as their international diffusion and green industrial policies are analysed using the above depicted framework to estimate their respective degree of political difficultness and the scope of change that can be achieved.

### **End of Pipe Policies**

Initially, environmental policies in industrialised countries largely focused on a clean-up and end-of-pipe approach, because this leaves the core activities of enterprises unchanged, their resistance is not that severe, and therefore this type of policies are easier to be adopted and implemented.

This type of policies rely to a large degree on command-and-control measures, that are imposed on the enterprises by (national) governmental actors. For the enactment of the underlying regulations, the environmental agencies are most important in the government. Other departments may be in opposition against the environmental standards, because they safeguard the economic interests of the target groups. Environmental NGOs are of little importance, they may act as watchdogs or as proponents of stricter standards.

Other levels of government than the national level are hardly of importance. For some environmental pollutants which have a long range dispersal, there are international regime set up (like OSPAR or the LRTP) that lead finally also to stricter national policies than they would have been enacted if there had been unilateral action only. The subnational level has some role to play in the implementation of the regulation and the monitoring of the compliance. However, in this mode of regulation, the nation state remains to be the most important driver.

The policy style is likely to be confrontational, since EOP measures do impose additional costs to the enterprises. The interests of the target group is likely to be rather homogenous in opposition against this type of regulations.

End of pipe measures do require the monitoring and control of the compliance of the regulations. Therefore the costs of regulation can be considerably, administrative capacities have to be build up. Empirically, the costs for the target group are almost neglectible, apart from few branches and enterprises for which standards were imposed that lead to considerable requirements for investment.

The deficits of this policies and the technologies that are favoured by this approach are well known: often, they tend to shift problems from one media to another only, rather than solving them, they are unnecessary expensive, while more encompassing solutions bear even the potential of cost savings, and for many problems end-of-pipe technologies are not available e.g. climate change or land use degradation (Binder 1999). Furthermore, once investments in end of pipe technologies have been undertaken, technological trajectories originate from this. Investments in integrated technologies cannot be expected until the investments are depreciated.

Largely, end of pipe policies do follow a traditional regulatory mode with a single regulator on the one side and a defined target group on the other side. The trends of governance, new actors, new instruments and shifts in the level of governance are of none or minor importance.

### **Innovation oriented environmental policies**

Technological environmental innovations, i.e. new processes and products that have a smaller burden on the environment than the comparable existing technologies, are expected to overcome at least some of the shortcomings of end of pipe technologies. The scope of policies that contribute to such a modernisation is much broader. It challenges the core processes and the products of enterprises. Unlike in the case of end-of-pipe regulations, the requirements cannot be met by adding a division of specialists. It requires R&D efforts by the enterprises, and it interferes with the central operations of enterprises. However, there is also a considerable market potential for technologies with higher efficiency.

There is a lack of investment in the R&D of environmental innovations because of the double externality of the profit that can be achieved by environmental innovations. Firstly, as for any R&D activities, there are spill over effects and secondly because the improvements in environmental quality are a public good the level of investments in R&D is lower than the economic optimum (Carraro 2000; Rennings 2000).

Therefore, the innovation and diffusion of environmental technologies depends largely on public regulation. This has been also underlined by empirical studies on environmental innovations (see Weale 1992; Klemmer, Lehr et al. 1999; Jänicke, Blazejczak et al. 2000). Based on the evaluation of innovation processes policy recommendations were derived in such studies. They encompass the “multi-impulse hypotheses” (Blazejczak, Edler et al. 1999) “design criteria” for environmental policies (Norberg-Bohm 1999) or proposals for a “strategic niche management” (Kemp, Schot et al. 1998).

The set of instruments for innovation oriented approaches are much broader compared to the command and control regulations that are imposed for end of pipe technologies. These type of instruments still play a role when it comes to technology forcing by which a certain standard is set obligatory at a certain future date. Most scholars, however, call for economic, persuasive or self regulatory instruments in order to stimulate successfully the development and diffusion of environmental innovations because such instruments leave some room for manoeuvre for the target group. Of particular importance are R&D subsidies in order to support the development of technologies.

Many studies reveal, that innovation effects cannot be ascribed to single instruments only. While in one case a particular instrument e.g. a product label, successfully stimulates innovations that are introduced into the market, the same policy instrument is not successful in other countries or sectors. Policy instruments are a necessary condition for innovation, but on their own, they are not sufficient.

The wide range of instruments that are applied hints to the fact that unlike in the case of end of pipe policies, there are much more governmental agencies involved in enacting and enforcing this policies than the environmental departments only. It is typically the ministries for the environment, for R&D/innovation and the respective sectoral ministry (agriculture, industry, transport, energy, etc.). Successful innovation oriented environmental policies require the integration of policies of different governmental agencies. However, initially policies of the different departments are fragmented, because of their diverging objectives.

It is still the level of the nation state that is most important for innovation oriented approaches, although their competences are challenged by Europeanisation and globalisation. It remains largely the nation state that frames the national innovation systems and that is able and legitimated to enact policies that direct the innovation activities towards a greening (s.a. Hübner and Nill 2001).

The policy style is often not confrontative but co-operative. However, the effectiveness of voluntary or persuasive instruments depends to a large degree on credible long-term commitments and on the (perceived) readiness to implement regulatory measures in case of failure. The target group is more likely to be fragmented than in the case of end-of-pipe policies. Whenever an innovator enters the stage, that is able to demonstrate the technical and economic feasibility of environmental innovations, the rest of the branch comes under political pressure to legitimise the ongoing utilisation of the old technologies.

The importance of long-term and credible policy objectives for innovation processes and by the above discussed growing importance of self regulatory and persuasive instruments, environmental NGOs may play a more significant role. Many policy instruments, in particular persuasive instruments are available to private actors as well. NGOs contribute to the development of objectives, communicating problems, monitoring the achievement of targets, thereby partially overtaking governmental functions. Growingly, there are private-private alliances between NGOs and firms that have the potential to influence environmental policy making to a large degree (Jacob and Jörgens 2001). However, these resources are hardly utilised strategically in the po-

licy process and empirically the role of NGO actions seems to be limited compared to initiatives of governmental actors.

Finally, innovation oriented environmental policies do require a longer time horizon than end of pipe policies. The time span from invention via market introduction to diffusion takes – depending on the technological sector at stake – often several years, sometimes even a decade.

Strategies for the stimulation of innovations vary regarding the degree of difficulty depending on the scope of the required change. If technologies are available and if they demonstrated their technical and economic feasibility the task is primarily to support their diffusion. Resistance of the target group can be expected only if the affected industries prefer to use their previous technologies for a longer period of time. If the required technologies are not yet on the market or only at high costs, there are two possibilities: Regulators may choose to set standards for a future date (technology forcing) (which is likely to evoke resistance by the target group or other governmental agencies) or they can subsidise the development and marketing of the environmental innovations (which may require considerable financial resources). Empirically it can be shown, that environmental policies more often support the diffusion of existing technologies, rather than requesting the development of new technologies (Conrad 1998, Jacob 1999). Policies are also easier to be adopted, if there are international examples for such policy measures. The examples of pioneering countries are often used to legitimise planned policies.

If environmental innovations are not a causal, sustained solution, the environmental relief might be compensated by subsequent growth processes. These facts were labelled already in the late 1970s as the "dilemma of the N curve" (Jänicke 1979: 111). This dilemma applies not only to clean-up environmental protection (end-of-pipe treatment) but also to efficiency improvements. For example, Japanese industries, between 1973 and 1985, succeeded in saving energy and raw materials in a remarkable way but the high industrial growth in those days simply devaluated this effect (Jänicke, Binder et al. 1997). The overall growth rate must thus always be accompanied by equivalent progress in (compensatory) technology providing environmental relief. This "*bare and tortoise-dilemma*" of ecological modernization is even tightened if there are losers of modernisation: If it is not the polluting industry itself which finds new opportunities in environmental friendly products, the sector often seeks for new sales opportunities for the old product. For example, the successful campaigns of environmentalists against using chlorine in applications free to the environment lead to a considerable reduction in production and consumption, but this has been compensated by the expansion of chlorine uses in other areas (Jacob 2001). Furthermore, an innovation oriented environmental policy is limited by the nature of the underlying problem: For urgent hazardous problems it is not adequate to wait for the polluters to innovate. Other problems, such as land use or the loss of biodiversity are not solvable by technologies at all (Jänicke and Jacob 2002).

Finally, an innovation oriented environmental policy is limited to those sectors where the target group has sufficient capacities to fulfil the expectations of environmental policy. It requires a sector that is able to perform R&D efforts and that has the ability to diversify into less harmful activities.

To conclude, innovation oriented strategies bear many features of the above mentioned trends of governance: New instruments are experimented with, new actors gain importance and, to a minor degree, other levels of policy making than the nation states become relevant. It remains, however, largely a task of national governmental actors to adopt and enforce such measures.

### **The diffusion of environmental innovations**

A strategy aiming at the stimulation of innovation should not be terminated after the market introduction of an environmental innovation. An encompassing modernisation requires both, innovations, that go beyond incremental innovations, but also their internationally widespread application. Since environmental innovations depend largely on regulatory measures, their international diffusion is frequently accompanied by the diffusion of the related policies.

There is a close interlink between the international diffusion of technological innovations and the spread of policies in support of these technologies. This is because policy makers seeking continuously for solutions that can be adopted also in their own countries and the example of other, pioneering countries is used to legitimise their national activities. Sometimes, the diffusion is already anticipated by the target group and therefore the technological standards are adopted if a country that is perceived as frontrunner in a particular field of policy making adopts respective policy measures (e.g. the exhaust gas standards that were enacted in California lead to R&D activities by many manufactures around the globe, or the Swedish prohibition of use of cadmium in the 1970s led to a substitution in all over Europe, without having the same legal requirements). The diffusion of technological and policy innovations is also supported by the fact that they often refer to global environmental needs: Since many environmental problems occur in great many countries at the same time, or are even globally in their nature they enjoy right at the outset a market perspective beyond national markets.

Recent comparative research on the spread of environmental policy among countries reveals an international convergence in the development of national policy patterns (Kern, Jörgens et al. 2000; Kern 2000; Jörgens 1996; Tews, Busch et al. 2003). The diffusion of innovations in environmental policy takes place both directly from one country to another, i.e. by way of imitative policy learning or "lesson drawing" (Rose 1993) and by way of international institutions (e.g. international regime), organisations (OECD, UNEP, World Bank, Greenpeace), or expert-networks (e.g. the International Network of Green Planners) (s.a. Jörgens 2003).

Initially, strategies that aim at utilising the mechanism of internationalisation build on the same set of instruments as any other technology based policy. It has to be noted, however, that there are differences in the international spread of instruments according to the type of policy innovation and the type of the underlying problem. Policies supporting marketable technologies e.g. by improvements in efficiency, are more likely to diffuse than those policies requesting e.g. EOP technologies that bear additional costs. Pioneering national environmental policy is more likely to diffuse, if it refers to environmental problems, which are highly visible and which are on the international agenda, e.g. climate change. Furthermore, distributive instruments (e.g. subsidies) or informational instruments are more likely to diffuse compared to regulatory instruments (e.g. command and control) or re-distributive policies (like eco-taxes).

Empirically, there are considerable differences in the rate of adaptation of environmental technologies and their related policies among the different countries. Some countries are earlier in introducing technologies and the penetration of markets is more encompassing than in others. If their innovations are subsequently adopted in other countries, they can be analysed as *lead markets* (Beise 1999; Beise 2001).

The history of environmental protection is rich in examples for lead markets (Beise, Blazejczak et al. 2003): it encompasses the legally enforced introduction of catalytic converters for automobiles in the United States, desulphurization technologies in Japan, the Danish support for wind energy or the CFC free refrigerator in Germany. Another impressive example is the global diffusion of chlorine-free paper, from the political activities by Greenpeace and the EPA in the United States, by way of the in-

roduction of chlorine-free paper whitener in Scandinavian countries and various Greenpeace campaigns in Germany and Austria, right through to effective political market intervention in Southeast Asian countries like Thailand (Mol and Sonnenfeld 2000). The latter case shows that political action that stimulates internationally successful innovations is not limited to governmental agencies only, but that this function at least regarding the process of setting environmental objectives may also be taken over by environmentalists.

From the analysis of these examples it can be inferred that the successful establishment of lead markets depends largely on the attainment of the image as a pioneer in environmental policy making. These countries are able to frame the expectations of industries on future regulations sometimes even globally. Furthermore, lead countries often dispose on competitive branches that are able to innovate and are that are already leading the technological development. Lead countries are able to raise the often considerable funds that are required to develop and to introduce innovative technologies.

Regarding the actors involved, international agents are of greater importance than in the types of strategies discussed so far. International organisations such as the OECD, the European Commission or UN agencies are continuously searching for best practices in both environmental policy making as well as environmental technologies in order to support their international diffusion. The negotiation in international regime often serve as an arena for pioneering countries that are able to spread their innovations by this (Jänicke 2002). Occasionally, multinational enterprises aim at levelling out different standards and they contributing to the spread of technologies as well as regulation in order to achieve this. Environmental NGOs support the international diffusion, their demands for an adoption of environmental friendlier technologies is additionally legitimated by the example of frontrunners. It has to be noted however, that the demonstration of the feasibility on the national level seems to be of greater importance compared to the transfer activities of often rather weak international actors.

The limits of strategies are very much alike the above mentioned approaches for an ecological modernisation. Additional actors in particular from the international level are more important for these policies, however they do not substitute the national governmental policies. It is unlikely that those innovations diffuse easily, that are lacking a win-win potential, e.g. structural solutions which primarily aim at abolishing polluting industries. However, the potential for such strategies is still under-utilised.

### **Green industrial policy**

Given the shortcomings of strategies of ecological modernisation it is called for even more far reaching approaches that go at the dispense of polluting industries. Green industrial policy is an economic policy that aims at reducing the environmental burden of industrial production by reducing the size of the most polluting sectors (inter-sectoral structural change). Green industrial policy is based on the assumption that the main share of the environmental burden in industrialised countries is caused by few industrial sectors, in particular the extraction of natural resources, energy production, production of metals, production of mineral products, chemical industry and the production of pulp and paper (Binder 2001).

It requires a shift not only in environmental and innovation policies but also in the economic and regional policies of a country. Unlike approaches of innovation oriented environmental policies that aims to identify win-win opportunities at least in the long term, by stimulating marketable and competitive technologies, an approach at the dispense of polluting industries generates losers. To be effective, a green industrial

policy needs to have a long-term focus and to be closely interlinked with other policy domains, notably economic policy and regional planning. In general, there should also be some mechanism to deal with, and possibly even to compensate for, the losers of structural change, which will require close links to social and welfare policies (see for example Jänicke, Binder et al. 1997; Binder, Jänicke et al. 2001).

There are few cases in which a green industrial policy has been developed at the expense of highly polluting sectors (Jänicke, Mönch et al. 2000). Examples are the phase-out of Japan's primary production of aluminium or the political strategy of minimising oil consumption after the explosion in oil prices in the early 1970s in many western industrialised countries. Another example is the German government's decision to phase out the use of nuclear power and their agreement with industry on a long-term plan to shutdown nuclear power stations. Other cases, namely the phasing out of coal mining in the Netherlands or of crude steel production in Luxemburg were not driven by environmental objectives although there has been a considerable environmental relief. In many sectors, pure economic rationales have led to the relative reduction of highly polluting industries, such as coal or steel (at times even an absolute reduction); in some cases, this decline even ran against actual industrial policies that governments had enacted to support old industries through subsidies and state protectionism. Hence, there is a considerable potential for environmental relief if this "autonomous" industrial restructuring is even supported by more progressive industrial policies rather than the often defensive and structurally conservative approaches that is primarily influenced by the vested interests of the affected industries. The basic industries still benefit from industrial policies more than sunrise industries regarding subsidies and protectionism (Binder, Jänicke et al. 2001).

Up to now, there is little research on the economic and political conditions for success of a shift of policies that support a decline of heavily polluting industries and support cleaner branches. It is called for a broad integration of different governmental agencies, in particular of the environment and industry, as well as the different levels of policy making from the regional to the national level.

Due to the manifold issues that have to be addressed, different types of instruments have to be applied, covering regulative and economic environmental policy instruments, all kinds of measures of industrial policies, regional planning and social policies to compensate possible losers of structural change and R&D/innovation policies in order to identify other business opportunities. Due to the nature of the policy problem, it is unlikely that persuasive or self regulatory instruments are of great importance for the management of structural change. The sheer magnitude of the problem also makes it unlikely that the losers can be bought out by distributive instruments.

Hence, considerable resistance against these policies can be expected, and the few examples for a purposeful industrial restructuring underline this assumption. The policy style is confrontational rather than consensus seeking.

In respect of non-governmental actors trade unions are important, but it is unlikely that they are promoting a green industrial policies which potentially bear disadvantages for their sector and therefore workplaces. Environmental NGOs played some important role in the restructuring of the Chemical Industries since the late 1980s (Jacob 2001) or in the case of energy industries in Germany with the abolishing of nuclear power and the incorporation of environmental objectives in energy policies (Piening 2001; Foljanty-Jost and Jacob 2004). The sectors that are subject of green industrial policies are often dominated by multinational companies, the goods that are produced by them are subject of international trade and the according trade agreements. By this, national strategies are somewhat hampered, however, the national level of policy making remains the most important.

To conclude, the proposals, as well as the few empirical cases for a green industrial policy follow largely traditional modes of governance, both in respect of the actors involved, instruments that are chosen and the level of governance.

### **Governance for Industrial Transformation**

The scope for policies that are able to influence and to transform systems as understood in the research on Industrial Transformation is even broader than the above described policies. A system in the parlance of IT encompasses the value chains of several branches, as well as the consumers, international trade and the institutional setting on all level of governance from local to international.

Some might argue, that things are complicated enough already, that policy makers hesitate to adopt ambitious policies already in face of the huge demands of an encompassing ecological modernization, not to mention the requirements of a green industrial policy.

However, the broadening of the scope bears additional chances as well. E.g. the perspective on the value chains rather than on the polluting branches might help to identify the “weakest” part of this chain: It can be assessed which branch might have gate keeper functions, which are able to innovate, whose interests are affected by the change and who are the most powerful actors. Accordingly policies can be adapted.

Based on this considerations, the playing ground for the involvement of non governmental actors and of other levels than the national level of policy making, as well as the introduction of new policy instruments can be seen from a different angle: If policy makers currently are not able to impose the required strict regulations, or to set the prices right – what other points for intervention can be found?

The contributions to the 2003 Berlin Conference addressing this issue in manifold directions. The papers in the panel sessions A (multi-actor and multi-level governance) mainly ask for the appropriate level of governance: Is it the nation state that is likely to bring forward the necessary changes? What contributions can be expected by the European level and what can be expected by international agreements? What is the interplay between the different levels of policy making – are the different policies coherent? Several papers deal with the question, if regional initiatives are likely to be successful or if local and regional actors are helpless facing the overwhelming forces of economic development and the global nature of environmental change.

The panel sessions B (transition strategies) are dealing with the question of how transition processes might be organized. What are the possibilities and obstacles to influence technological regimes? The development of transition strategies is impelled by the Dutch government for different sectors – in how far are these efforts likely to be successful? Are they limited to the specific political context and culture of the Netherlands? What actors are likely to promote transition strategies, what instruments are available to bring forward the desired changes? A special focus is given to the question at what point of time interventions are most likely to be successful. It will be discussed, if early phases of transition processes can be effectively influenced by R&D policies. Other contributions analyse, in how far political cycles and business cycles might be adapted to each other, thereby making interventions more effectively and efficiently.

Contributions in panel sessions C (sustainable business) analyse the conditions for action in the various sectors. Special focus is given to water, energy and agriculture. It will be analysed in how far voluntary actions by business actors can be expected and what instruments are likely to stimulate corporate responsibilities. In how far are these persuasive, self regulatory instruments also available to non-state actors? Are the emerging business-NGO partnerships likely to promote changes?

The panel sessions D (technologies for a sustainability transformation) contribute to the informational basis for policies and consumer behavior. What lessons can be drawn from past developments? Is it possible to model future economic developments based on this past experiences? What methods are available to forecast the technological development and to adapt policies accordingly? What are the determinants of consumer behavior and how could these be influenced?

Finally, the panel sessions E (new generations of instruments) discusses if the new generation of instruments that are currently adopted in many countries around the world are contributing to the undertaking of Industrial Transformation. Several papers evaluate the effectiveness of environmental managements systems that have been introduced some years ago. What are the possibilities for governmental policies to set right the prices? What persuasive and informational instruments are in practice to stimulate voluntary action; what kind of opportunities and impediments can be observed in their application? It has to be investigated if the trend to more flexible instruments with a low degree of determination is symbolic policy only or if they contribute to substantial outcomes.

A cross cutting issue of the conference is the question in how far the experiences with new actors, new instruments and the incorporation of new levels of government are likely to be applicable in Southern countries as well. Are policy innovations of this kind limited to the rich industrialized countries only, given the often poor financial, economic and administrative resources in less developed countries? Or just the opposite: Are new instruments, new actors or the incorporation of the international and subnational level able to level out this deficits? To make a fruitful discussion possible in this respect we avoided to put papers together in a separate panel session, but instead we distributed this contributions on problems in developing countries in the various sessions.

The 2003 Berlin Conference shall not be the final effort in strengthening research activities facing the urgent need for an encompassing Industrial Transformation. It aims at stimulating the international and interdisciplinary debate on this issues. Hopefully, many new research projects and co-operations will follow out of this meeting.

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